

CSCI Integration Test Procedure for
APU Neural Net Tool
Checkout and Launch Control Systems (CLCS)

84K06621-002-02

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1. SCOPE

This document defines the test approach and procedures to be executed for THOR delivery of APU Neural Net Tool by CLCS Software Development. Testing will occur at the Kennedy Space Center in either the Processing Control Center (PCC) on an office workstation, or in the Launch Control Center Integrated Development Environment on the Business and Information Network.

1.1 IDENTIFICATION

This document is the Checkout and Launch Control System (CLCS) THOR Delivery CSCI Integration Test Procedures for APU Neural Net Tool Document, 84K06621-002-02.

1.2 PURPOSE

The purpose of this document is to define a suite of test procedures that will accurately assess the delivered software to ensure it is functional and meets project commitments for the THOR delivery.

1.3 CSCI OVERVIEW

The APU Neural Net Tool (ANNT) is a collection of UNIX , C, and Gensym G2/NOL software applications that provide a method to monitor/analyze the Auxiliary Power Units (APUs). ANNT resides on the SDC Advanced Application Server. To access ANNT, a web browser is started on a CLCS workstation. The browser is navigated to the ANNT URL and the ANNT button is clicked on. The web server sends a PC-Xware script to open a connection to the CLCS Workstation. The web browser on the CLCS Workstation launches PC-Xware and runs the script. The script opens a connection to the SDC Advanced Application Server. ANNT is started on the Advanced Application Server and displayed on the CLCS Workstation (via xhost). The first screen displayed on the CLCS Workstation is a matrix showing available vehicle and historical data. The user selects which data source ANNT will monitor and then the ANNT main screen appears.

1.4 HARDWARE AND SOFTWARE CONFIGURATIONS

1.4.1 The following hardware is needed for the APU Neural Net Test Plan:

- A CLCS workstation in the Integrated Development Environment with a 100MB Ethernet link to the Advanced Application Server.
- A BASIS support workstation in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

1.4.2 The following software configuration will be needed on the CLCS workstation: Netscape Navigator 4.0 or higher Web Browser

- NCD's PC-Xware

- Configure web browser to launch PC-Xware application.

1.4.3 The following software configuration will be needed on the DEC Alpha Server

- G2
- Java
- ANNT Knowledge Base
- ANNT G2 Standard Interface program
- Data Services

1.5 DOCUMENT ORGANIZATION

This document is divided into three sections and four appendices:

Section 1, Scope, discusses the purpose of the CSCI Integration Test, provides a system overview , and describes software and hardware configurations for the system.

Section 2, Applicable Documents, lists the documents used to create and those supporting this document.

Section 3, Test Case Description, contains a description of the test cases, the pass/fail criteria, and the procedures in detail.

Appendix A, Acronyms and Definitions, contains a listing of acronyms and selected word definitions (for words which may have multiple interpretations)

Appendix B, Requirements Traceability and Test Methods Matrix, contains the requirements verification matrix for the test.

Appendix C, Resource Requirements, contains a list of software, hardware, and personnel requirements necessary for each test.

Appendix D, Standard Operating Test Procedures, contains any specific, standard procedures identified within the test cases.

2. APPLICABLE DOCUMENTATION

The following documents, of the revision shown, form a part of this document to the extent specified.

2.1 PARENT DOCUMENTS

The documents in this paragraph establish the criteria and technical basis for the existence of this document. The parent documents are:

Parent Document	Document Number	Rev.	Date
<i>CLCS System Test Plan</i>	84K0056	BASIC	3/27/97
<i>CLCS Program Management Plan</i>	84K0050	BASIC	N/P
<i>CLCS System Engineering Management Plan (SEMP)</i>	84k0053	BASIC	N/P
<i>CLCS Project Plan</i>	84K0051	BASIC	N/P
<i>Thor Delivery Document</i>	84K00150-001	unsigned	
<i>THOR Design Panel 3 APU Neural Net Tool</i>	84K-01800-020	1.0	10/31/97

Table 2.1: Parent Documents

2.2 APPLICABLE DOCUMENTS

Applicable documents are those documents which form a part of this document. These documents, at the revisions listed below, carry the same weight as if they were stated within the body of this document.

Applicable Document	Document Number	Rev.	Date
<i>CLCS System Level Specification</i>	84K00200	BASIC	6/26/97
<i>Safety & Mission Assurance (S&MA) Plan</i>	84K00055	BASIC	4/28/97
<i>CLCS CM Plan</i>	84K00052	N/P	-
<i>CLCS Integration Management Plan</i>	N/P	-	-
<i>APU Neural Net Tool Users Guide></i>	84K07521-001	-	-

Table 2.2: Applicable Documents

2.3 REFERENCE DOCUMENTS

Reference documents are those documents which, though not a part of this document, serve to clarify the intent and contents of this document.

Reference Document	Document Number	Rev.	Date
<i>CLCS Certification Plan</i>	N/P	-	-
<i>CLCS System Design Document</i>	84K00200	Basic	June 26, 1997

Table 2.3: Reference Documents

3. TEST CASE DESCRIPTION

This section describes each test case, the expected results, the pass/fail criteria, and a step by step procedure to execute the test. Appendix B contains the Requirements Traceability and Test Methods Matrix, which maps functional requirements to the test case that verifies those requirements

3.1 SYSTEM INITIALIZATION

This test case is intended to demonstrate the initialization process of the APU Neural Net Tool.

3.1.1 Test Description

3.1.1.1 Detailed Description

This test case will demonstrate the complete system initialization process beginning with the hardware powered-up, browser initiation, navigation to the ANNT URL, connection to the CLCS workstation, connection to the SDC Advanced Application Server, G2/ANNT initialization, data selection from the data matrix, and demonstration of the ANNT main display.

3.1.1.2 Resource Requirements

3.1.1.2.1 Test Personnel

Personnel required includes a Test Conductor, a Quality Assurance Witness, and a BNA representative. The Skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.1.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100MB Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.1.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.1.1.2.4 Data

The following data is required:

- The file named alan.s0007.sb087b will be used to test each element of the main display.

3.1.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.1.1.1	ANNT shall be developed using Gensym G2 and NeurOn-Line software.
1.2.2.1.1.2	ANNT shall be connected to CLCS Support workstations using NCD's PC-Xware.
1.2.2.2.1.1	ANNT shall be capable of being evoked from a web browser on a CLCS Support Workstation

3.1.2 Pass/Fail Criteria

The test case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

3.1.3 Procedure

Refer to Procedure 3.1 in Table 3.1 for test procedures.

Procedure 3.1 - System Initialization					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions None					
Step	Description	Expected Results	Comments	TC	QA
1.	Turn Power on Workstation In the future you do not need to be this specific. Some conditions are a given.	Computer boots to expected prompt to begin testing.			
2.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
3.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
4.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the application			
5.	Click on the “APUNET” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				
6.	A prompt will appear asking for a userid and password. Fill in the proper information. This verifies that ANNT is connected to CLCS Support workstations using NCD’s PC-Xware.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear.			
7.	On the ANNT Selection Matrix, click on the data pull down menu. Verify that a file by the name of alan.s0007.sb087b appears in the pull down menu.				
8.	Click on the alan.s0007.sb087b file.	This will feed the playback alan.s0007.sb087b into G2 such that ANNT has a data file to run.			
9.	This verifies that ANNT is capable of being evoked from a web browser on a CLCS Support Workstation Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			

10.	Click in the background again and click on MISCELLANY.				
11.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
12.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
13.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.1

End Time: _____

Signature Page: Test Case 3.1 - System Initialization

Quality Assurance **Date**

Test Conductor **Date**

Comments:

3.2 MAIN DISPLAY

This test case is intended to demonstrate the APU Neural Net main display functionality. The data for all three APUs shall be displayed and analyzed.

3.2.1 Test Description

3.2.1.1 Detailed Description

This user will inspect each of the components on the main display and verify that they exist.

3.2.1.2 Resource Requirements

3.2.1.2.1 Test Personnel

Personnel required includes a Test Conductor, a Quality Assurance Witness, and a BNA representative. The Skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.2.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100MB Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.2.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.2.1.2.4 Data

The following data is required:

- The file named alan.s0007.sb087b will be used to test each element of the main display.

3.2.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.4.1.1	The main display shall provide all three APU outputs.
1.2.2.4.1.2	The main display shall have colored indicators designating the state of each APU.
1.2.2.4.1.3	The main display shall include a legend to indicate conditions vs. color.
1.2.2.4.1.4	The main display shall include a mode indicator.
1.2.2.4.1.5	The main display shall display APU chamber pressure designated by V46P0120A.
1.2.2.4.1.6	The main display shall display APU chamber pressure designated by V46P0220A.

1.2.2.4.1.7	The main display shall display APU chamber pressure designated by V46P0320A.
1.2.2.4.1.8	The main display shall have a button to access each sub-display.
1.2.2.8.1.1	The start-up algorithm shall notify the user that APU start-up has occurred.
1.2.2.11.1.1	Main display and neural net classification must occur in less than 500 ms.

3.2.2 Pass/Fail Criteria

The test case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

3.2.3 Procedure

Refer to Procedure 3.2 in Table 3.2 for test procedures.

Procedure 3.2 - Main Display					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions - None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “APUNET” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				
5.	A prompt will appear asking for a userid and password. Fill in the proper information. This verifies that ANNT is connected to CLCS Support workstations using NCD’s PC-Xware.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear.			
6.	On the ANNT Selection Matrix, click on the data pull down menu. Click on the file alan.s0007.sb087b.	This will launch the process of starting G2. This will take about 1 minute.			
7.	Click in the top right hand corner of the window to expand it .				
8.	The user shall look to see if the Countdown clock is present on the main display.	Clock display is in the upper right hand corner.			
9.	The user shall verify that the mode indicator for each APU is displaying APU “Prestart”.	This indicator is located just above each display.			
10.	The user shall look to see if the STS flight number is present and the value is “0” on the main display.	STS flight number display is below the Countdown clock. The value will be 0.			

11.	The user shall look to see if the OV- Shuttle number is present and the value is "0".	OV- number display is below the STS flight number display.			
12.	The user shall verify that a button exists under each APU display to access the corresponding sub-display.	Sub-display verification will be performed later in the test.			
13.	The user shall verify that a legend exists to define the color usage on the APU status buttons.	Tan is De-activated, Green is active, and Red signifies an error condition is occurring. Yellow signifies an Indeterminate			
14.	The user shall verify that when the Countdown clock reaches (minus) -4:50, APU start-up occurs on APU1 first, followed by APU2, then APU3.	Note, step 13 should be performed at the same time.			
15.	The user shall verify that the mode indicator text has changed to "APU Startup".	This verifies that the Start-up algorithm is functioning properly.			
16.	Verify that the chamber pressures V46P0120A are scrolling across the top graph				
17.	Verify that the chamber pressures V46P0220A are scrolling across the middle graph				
18.	Verify that the chamber pressures V46P0320A are scrolling across the bottom graph				
19.	Verify that the main display and neural net classification occurs in less than 500ms by inspecting the message board in the top left corner and the number should be less than 0.5 seconds.				
20.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			
21.	Click in the background again and click on MISCELLANY.				
22.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
23.	A smaller window will appear to ask if shutdown is OK . Click on OK.				

24.	The ANNT selection matrix window will appear.				
25.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.2

End Time: _____

Signature Page: Test Case 3.2 - Main Display

Quality Assurance **Date**

Test Conductor **Date**

Comments:

3.3 SUB-DISPLAY

This test case is intended to demonstrate the APU Neural Net sub-display. The sub-display for each APU can be accessed from the main display.

3.3.1 Test Description

3.3.1.1 Detailed Description

The user shall verify that for APU1 (V46P0120A), APU2 (V46P0220A), APU3 (V46P0320A), chamber pressures are present. On each sub-display, a pulse diagnostic window exists and an Extrapolation vs. Classification chart exists.

3.3.1.2 Resource Requirements

3.3.1.2.1 Test Personnel

Personnel required include a Test Conductor, a Quality Assurance Witness, and a BNA representative. The skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.3.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100 Mbit Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.3.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.3.1.2.4 Data

The following data is required:

- The file named alan.s0007.sb087b will be used to test each element of the sub-display.

3.3.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.5.1.1	Sub-display 1 shall display APU chamber pressure designated by V46P0120A
1.2.2.5.1.2	Sub-display 1 shall display a pulse diagnostic window for V46P0120A
1.2.2.5.1.3	Sub-display 1 shall display an extrapolation vs. classification chart for V46P0120A
1.2.2.5.1.4	Sub-display 2 shall display APU chamber pressure designated by V46P0220A

1.2.2.5.1.5	Sub-display 2 shall display a pulse diagnostic window for V46P0220A
1.2.2.5.1.6	Sub-display 2 shall display an extrapolation vs. classification chart for V46P0220A
1.2.2.5.1.7	Sub-display 3 shall display APU chamber pressure designated by V46P0320A
1.2.2.5.1.8	Sub-display 3 shall display a pulse diagnostic window for V46P0320A
1.2.2.5.1.9	Sub-display 3 shall display an extrapolation vs. classification chart for V46P0320A

3.3.2 Pass/Fail Criteria

The Test Case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

3.3.3 Procedure

Refer to Procedure 3.3 in Table 3.3 for test procedures.

Procedure 3.3 - Sub Display					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “APUNET” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				
5.	A prompt will appear asking for a userid and password. Fill in the proper information.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear.			
6.	On the ANNT Selection Matrix, click on the data pull down menu.				
7.	Click on the alan.s0007.sb087b file. This will feed the playback alan.s0007.sb087b into G2 such that ANNT has a data file to run.	The G2 main display will appear.			
8.	On the main display, select Sub-display 1 by clicking on sub-display 1 button.	The ANNT sub 1 display appears.			
9.	The user shall look to see if the countdown clock is present on the sub-display 1.	Clock display is in the upper right hand corner.			
10.	The user shall verify that the APU chamber pressure is shown as a scrolling wave in the top display.	This chamber pressure is V46P0120A.			
11.	The user shall verify that a pulse diagnostic window displays each chamber pressure pulse on sub-display 1.	This window shows each chamber pressure			

		(V46P0120A) pulse as it is passed to the Neural Net.			
12.	The user shall verify that an Extrapolation vs. Classification chart resides on sub-display 1.	This window displays the confidence of each decision.			
13.	The user shall click on the close button and verify that control is returned to the main display.				
14.	Select Sub-display 2 by clicking on sub-display 2 button	The ANNT sub 2 display appears.			
15.	The user shall look to see if the countdown clock is present on the sub-display 2.	Clock display is in the upper right hand corner.			
16.	The user shall verify that the APU chamber pressure is shown as a scrolling wave in the top display.	This chamber pressure is V46P0220A.			
17.	The user shall verify that a pulse diagnostic window displays each pulse on sub-display 2.	This window shows each pulse as it is passed to the Neural Net.			
18.	The user shall verify that an Extrapolation vs. Classification chart resides on sub-display 2.	This window displays the confidence of each decision.			
19.	The user shall click on the close button and verify that control is returned to main display.				
20.	Select Sub-display 3 by clicking on sub-display 3 button	The ANNT sub 3 display appears.			
21.	The user shall look to see if the countdown clock is present on the sub-display 3.	Clock display is in the upper right hand corner.			
22.	The user shall verify that the APU chamber pressure is shown as a scrolling wave in the top display.	This chamber pressure is V46P0320A.			
23.	The user shall verify that a pulse diagnostic window displays each pulse on sub-display 3.	This window shows each pulse as it is passed to the Neural Net			
24.	The user shall verify that an Extrapolation vs. Classification chart resides on sub-display 3.	This window displays the confidence of each decision.			
25.	The user shall click on the close button and verify that control is returned to the main display.				
26.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			

27.	Click in the background again and click on MISCELLANY.				
28.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
29.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
30.	The ANNT selection matrix window will appear.				
31.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.3

End Time: _____

Signature Page: Test Case 3.3 - Sub-display

Quality Assurance **Date**

Test Conductor **Date**

Comments:

3.4 NEURAL NET FUNCTIONALITY

This test case is intended to demonstrate the functionality of the APU Neural Nets.

3.4.1 Test Description

3.4.1.1 Detailed Description

This test case will prove the ANNT Neural Net functionality by demonstration. A playback file will be fed into the tool. The results will be seen in the main and sub-displays. The sub-displays will be viewed to observe the actual neural net output as well as each individual waveshape in the pulse diagnostic window. The main display will be viewed to observe the rule recognition.

3.4.1.2 Resource Requirements

3.4.1.2.1 Test Personnel

Personnel required include a Test Conductor, a Quality Assurance Witness, and a BNA representative.. The skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.4.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100Mbit Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.4.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.4.1.2.4 Data

The following data is required:

- The file named alan.s0007.sb087b will be used to test each Neural Net case.

3.4.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.7.1.1	A neural net shall recognize a nominal waveshape.
1.2.2.7.1.2	A neural net shall recognize an Aero gimballing waveshape.
1.2.2.7.1.3	A neural net shall recognize an Engine gimballing waveshape.
1.2.2.9.1.1	The wave-detection algorithm shall recognize each individual waveshape.

1.2.2.9.1.2	The wave-detection algorithm shall window out each individual waveshape.
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3.4.2 Pass/Fail Criteria

The Test Case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

3.4.3 Procedure

Refer to Procedure 3.4 in Table 3.4 for test procedures.

Procedure 3.4 - Neural Net Functionality					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions - None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “APUNET” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				
5.	A prompt will appear asking for a userid and password. Fill in the proper information.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear.			
6.	On the ANNT Selection Matrix, click on the data pull down menu.				
7.	The user selects the data pull down menu and selects playback file alan.s0007.sb087b.	In approximately one minute, G2/NOL will appear and ANNT will load up automatically.			
8.	At -4:50 seconds on the countdown clock, the APU start up will occur.	There can be a few minute wait till the countdown clock runs down to -4:50.			
9.	Click on sub-display 2 button.	The ANNT sub 2 display appears.			
10.	The user shall verify that the neural net has recognized the nominal waveforms by viewing the Extrapolation vs. Classification window. A bar graph shows a pulse at the appropriate status level.	Ext. vs. Class window shows the direct Neural Net output vs. the extrapolation value. The status levels can be seen on left in			

		blue.			
11.	The user will continue to watch the scrolling strip chart in the sub-display until -3:50. The user should see three rapid pulses larger than the nominal pulses. These are Aero gimbaling pulses. Verify that the neural net recognized the Aero gimbaling by viewing the Extrapolation vs. Classification window. The classification graph will change states to the Aero gimbaling level.	The Extrapolation vs. Classification window displays the true neural net classification.			
12.	As the clock reaches -3:30, watch the scrolling strip chart display. Five larger and higher frequency pulses shall occur. These are engine gimbaling pulses. When the user recognizes the Engine gimbaling, look at the Ext. vs. Classification window to see if the neural net recognized the Engine gimbaling. The classification graph will change states to the Engine gimbaling level.	The Extrapolation vs. Classification window displays the true neural net classification.			
13.	Verify that Pulse diagnostic display has windowed and displayed each individual waveshape.	The waveshapes should be changing at approximately 1-2 cycle per second.			
14.	Click on the close button.	This returns control to the main menu.			
15.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			
16.	Click in the background again and click on MISCELLANY.				
17.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
18.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
19.	The ANNT selection matrix window will appear.				
20.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.4

End Time: _____

Signature Page: Test Case 3.4 - Neural Net Functionality

Quality Assurance

Date

Test Conductor

Date

Comments:

3.5 KNOWLEDGE BASE RULE FUNCTIONALITY

This test case is intended to demonstrate the functionality of the knowledge base rules and the wave-detection algorithms.

3.5.1 Test Description

3.5.1.1 Detailed Description

This test case will prove the ANNT Knowledge Base rule functionality and wave-detection algorithm by demonstration. A playback file will be fed into the tool. The results will be seen in the main and sub-displays. The sub-displays will be viewed to observe the actual neural net output as well as each individual waveshape in the pulse diagnostic window. The main display will be viewed to observe the rule recognition.

3.5.1.2 Resource Requirements

3.5.1.2.1 Test Personnel

Personnel required include a Test Conductor, a Quality Assurance Witness, and a BNA representative. The skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.5.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100Mbit Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.5.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.5.1.2.4 Data

The following data is required:

- The file named alan.s0007.sb087b will be used to test each Neural Net case.

3.5.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.10.1.1	The knowledge base rules shall detect an Aero gimballed waveshape.
1.2.2.10.1.2	The knowledge base rules shall detect an Engine gimballed waveshape.

3.5.2 Pass/Fail Criteria

The test case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

3.5.3 Procedure

Refer to Procedure 3.5 in Table 3.5 for test procedures.

Procedure 3.5 - Knowledge Base Rule Functionality					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions - None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “ANNT” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				
5.	A prompt will appear asking for a userid and password. Fill in the proper information.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear.			
6.	On the ANNT Selection Matrix the user selects the data pull down menu and selects playback file alan.s0007.sb087b.	In approximately one minute, G2/NOL will appear and ANNT will load up automatically.			
7.	At -4:50 seconds on the countdown clock, the APU start up will occur and the user will check the mode box and verify that the mode has changed from “Pre-Start” to “running”.	There can be a few minute wait till the countdown clock runs down to -4:50.			
8.	Continue to monitor the main display window until - 3:50. Verify that when the user recognizes the Aero gimballing waveshapes, the “Aero Gimballing” indicator light turns green.	The Aero gimballing light on the right side of the scrolling strip chart will turn green and the nominal indicator light will turn tan.			
9.	Continue to monitor the main display window until - 3:30. Verify that when the user recognizes the Engine gimballing waveshapes, the Engine gimballing indicator light turns green.	The Engine gimballing indicator light will turn green and the Nominal and Aero gimballing light on the right side of the			

		scrolling strip chart will be tan and the nominal indicator light will be tan.			
10.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			
11.	Click in the background again and click on MISCELLANY.				
12.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
13.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
14.	The ANNT selection matrix window will appear.				
15.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.5

End Time: _____

Signature Page: Test Case 3.5 - Knowledge Base Rule Functionality

Quality Assurance

Date

Test Conductor

Date

Comments:

3.6 REAL TIME DATA ACCESS

This test case is intended to demonstrate the functionality of accessing real-time data.

3.6.1 Test Description

3.6.1.1 Detailed Description

This test case will demonstrate the capability to retrieve real-time data through the ANNT Selection Matrix and the data will be displayed on the main display.

3.6.1.2 Resource Requirements

3.6.1.2.1 Test Personnel

Personnel required include a Test Conductor, a Quality Assurance Witness, and a BNA representative. The skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.6.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100Mbit Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.6.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.6.1.2.4 Data

The following data is required:

- None.

Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.3.1.1	ANNT shall use SDS CCMS real-time data.
1.2.2.6.1.1	DSSM display shall provide access to testing real time data.
1.2.2.6.1.3	DSSM shall provide data for OV-102, OV-103, OV-104, OV-105 when available.

Pass/Fail Criteria

The test case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

Procedure

Refer to Procedure 3.6 in Table 3.6 for test procedures.

Procedure 3.6 - Real Time Data Access					
Date:		Location:		Start Time:	
Test Setup/Initial Conditions None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “ANNT” icon (located at the bottom of the page under the “Boeing Advisory Systems Index”				

	heading.				
5.	A prompt will appear asking for a userid and password. Fill in the proper information.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear. (Figure 3.1).			
6.	On the ANNT Selection Matrix, under the Real Time Data Source window, select the TCID sb090A1 which corresponds to STS90 and OV-102.	This verifies that any active OV data streams can be accessed.			
7.	Verify that the GMT clock in the top, right hand corner is correct.	This verifies that data from SDS CCMS real time data can be accessed.			
8.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			
9.	Click in the background again and click on MISCELLANY.				
10.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
11.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
12.	The ANNT selection matrix window will appear.				
13.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.6

End Time: _____

Signature Page: Test Case 3.6 - Real Time Data Access

Quality Assurance

Date

Test Conductor

Date

Comments:

3.7 HISTORICAL DATA ACCESS

This test case is intended to demonstrate the functionality of accessing historical data.

3.7.1 Test Description

3.7.1.1 Detailed Description

This test case will demonstrate the capability to retrieve historical data through the Data Source Selection Matrix and the data will be displayed on the main display.

3.7.1.2 Resource Requirements

3.7.1.2.1 Test Personnel

Personnel required include a Test Conductor, a Quality Assurance Witness, and a BNA representative. The Skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.7.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100Mbit Ethernet link to the Advanced Application Server.
- An Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.7.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.7.1.2.4 Data

The following data is required:

- None.

3.7.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.3.1.2	ANNT shall use SDC CCMS historical data.
1.2.2.6.1.2	DSSM display shall provide access to testing historical data.

3.7.2 Pass/Fail Criteria

The test case shall fail if any step that is intended to satisfy a functional requirement produces a result that is not equal to the expected result.

3.7.3 Procedure

Refer to Procedure 3.7 in Table 3.7 for test procedures.

Procedure 3.7 - Historical Data Access					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions - None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “ANNT” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				

5.	A prompt will appear asking for a userid and password. Fill in the proper information.	In about 30 seconds, the "ANNT's Selection Matrix" will appear.			
6.	On the ANNT Selection Matrix the user shall fill in a start time of 1938, a start date of 111997, a stop time of 1955, and a stop date of 111997. The user fill in the TCID text box with sb087b. Click on the "Connect to SDC CCMS Data" button.	In approximately one minute, G2/NOL will appear and ANNT will load up automatically.			
7.	Click in the top right hand corner of the G2 window to maximize it.	Larger viewing area.			
8.	Verify that the GMT clock is functioning properly.	Clock is counting up.			
9.	At -4:45 seconds on the countdown clock, verify that the APU start-up has occurred.	There can be a few minute wait till the countdown clock runs down to -4:45.			
10.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			
11.	Click in the background again and click on MISCELLANY.				
12.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
13.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
14.	The ANNT selection matrix window will appear.				
15.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.7

End Time: _____

Signature Page: Test Case 3.7 - Historical Data Access

Quality Assurance

Date

<hr/>	<hr/>
Test Conductor	Date

Comments:

3.8 BROKEN VALVE ERROR CHECKING

This test case is intended to demonstrate that the APU Neural Net can recognize the conditions of an APU with a broken valve.

3.8.1 Test Description

3.8.1.1 Detailed Description

This test case will prove the ANNT Neural Net can recognize a "Broken Valve" waveshape by demonstration. A playback file will be fed into the tool. The results will be seen in the main displays and state indicators.

3.8.1.2 Resource Requirements

3.8.1.2.1 Test Personnel

Personnel required include a Test Conductor, a Quality Assurance Witness, and a BNA representative. The Skills required by a test conductor include UNIX workstation experience, G2 experience, APU experience.

3.8.1.2.2 Hardware

The following hardware is required:

- A CLCS workstation in the Integrated Development Environment with a 100Mbit Ethernet link to the Advanced Application Server.
- A DEC Alpha Advanced Application server in the LCC.
- Web Server with PC-Xware link to ANNT on the Advanced Application Server.

3.8.1.2.3 Software

The following Software is required:

- Netscape Navigator 4.0 or higher Web Browser
- NCD's PC-Xware
- Configure web browser to launch PC-Xware application.

3.8.1.2.4 Data

The following data is required:

- STS 31 broken valve data

3.8.1.3 Requirements Summary

This test case demonstrates that the following functional requirements are met:

Requirement Number	Description
1.2.2.7.1.4	APU Neural Net Tool shall recognize a broken valve waveshape.

3.8.2 Pass/Fail Criteria

The test case shall fail if any step that is intended to satisfy a functional requirement is not equal to the expected result.

3.8.3 Procedure

Refer to Procedure 3.8 in Table 3.8 for test procedures.

Procedure 3.8 - Broken Valve Recognition					
		Date:	Location:	Start Time:	
Test Setup/Initial Conditions - None					
Step	Description	Expected Results	Comments	TC	QA
1.	At the CLCS workstation, double click on the Netscape browser button on the desktop.	The Netscape application window opens up and is active for the next step.			
2.	In the location text box of Netscape, type in http://lps12/~richeyre/clcs/clcsstrt.htm and press enter.	Netscape navigates to the “BASIS - Business And Support Information Service” web page.			
3.	Click on the “Advisory Systems ...” icon (located on the left hand side of the window).	Netscape navigates to the “UNIX Sun Applications” web page.			
4.	Click on the “APUNET” icon (located at the bottom of the page under the “Boeing Advisory Systems Index” heading.				
5.	A prompt will appear asking for a userid and password. Fill in the proper information.	In about 30 seconds, the “ANNT’s Selection Matrix” will appear.			
6.	Click on the “Cases” pull-down menu and select sts31.	In approximately one minute, G2/NOL will appear and ANNT will load up automatically.			
7.	Click in the top right hand corner of the G2 window to maximize it.	Larger viewing area.			
8.	Click on the broken valve button.	The subdisplay window will appear.			
9.	Nominal, Aero, and Engine gimbaling waves will occur for the first 1.5-2 minutes. The waveshapes are visible in top scrolling strip chart display. The broken valve condition will occur and it can be recognized by a chopped off waveshape.	There can be a few minute wait till the countdown clock runs down to -4:45. Also note that the neural net is classifying each of the waveshapes in the Extrapolation vs. Classification display.			

10.	Verify that when the wave shape pulse goes flat, the error indicator light turns red and the classification value in the Extrapolation vs. Classification display rises to the Error level.	The error indicator light turns red. This verifies that the Broken Valve condition is recognized.			
11.	Pause G2 by clicking in the background and clicking on the pause button.	The background is a pattern of the word GENSYM in small letters in the color gray.			
12.	Click in the background again and click on MISCELLANY.				
13.	A new list will appear with the option to shutdown G2. Click on the shutdown g2 message.				
14.	A smaller window will appear to ask if shutdown is OK . Click on OK.				
15.	The ANNT selection matrix window will appear.				
16.	On the ANNT Selection Matrix, click on the file pull down menu. Click on exit.	This will shutdown the ANNT selection matrix.			

Table 3.8

End Time: _____

Signature Page: Test Case 3.8 - Broken Valve Recognition

Quality Assurance

Date

Test Conductor

Date

Comments:

APPENDIX A ACRONYMS AND DEFINITIONS

<i><acronym></i>	<i><Definition></i>
ANNT	APU Neural Net Tool
APU	Auxiliary Power Unit
AT	Acceptance Test - Test to accept hardware and software from a vendor
Certification	Final approval to use a system for a specified set of operations (e.g., hazardous operations in the HMF, launch operations, etc.)
CI	Configuration Item
CIT	CSCI Integration Test
CLCS	Checkout and Launch Control System
CM	Configuration Management
COTS	Commercial Off The Shelf
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
DAR	Delivery Acceptance Review
EDL	Engineering Development Laboratory
GSE	Ground Support Equipment
HCI	Human Computer Interface
HMF	Hypergol Maintenance Facility
HW	Hardware
HWCI	Hardware Configuration Item
IDE	Integrated Development Environment
I/F	Interface
KSC	Kennedy Space Center
LAN	Local Area Network
LCC	Launch Control Complex
LMSMS	Lockheed Martin Space Mission Systems and Services
LPS	Launch Processing System
NASA	National Aeronautics and Space Administration
MSC	Mission Systems Contract (held by LMSMS)
OS	Operating System

PTR	Post-Test Review
PR	Problem Report
QA	Quality Assurance
QE	Quality Engineering
QT	Qualification Test
RLV	Reusable Launch Vehicle
RTPS	Real Time Processing System
RVM	Requirements Verification Matrix
SDC	Shuttle Data Center
SDE	Satellite Development Environment
SEMP	System Engineering Management Plan
SFOC	Space Flight Operations Contract (held by USA)
ST	System Test
SLWT	Super Light Weight Tank
S&MA	Safety and Mission Assurance (includes Reliability, Maintainability, Safety and Quality Assurance)
STS	Space Transportation System
SW	Software
TC	Test Conductor
TPR	Test Progress Review
TR	Test Report
TRR	Test Readiness Review
UAT	User Acceptance Test - Test performed by user community post delivery as part of the system certification process
UIT	Unit Integration Test
USA	United Space Alliance
UT	Unit Test
Validation	Testing performed by organization(s) outside of the developing organization to ensure that the delivered system processes data correctly and conforms to the operations concepts

APPENDIX B REQUIREMENTS TRACEABILITY AND TEST METHODS MATRIX

The following table is intended to show which CLCS Functional Requirement is demonstrated in each CLCS <CSCI/CSC Name> CSCI Integration Test (CIT) and what test method was used in that test case. This table will be updated and baselined with each CIT starting with the Redstone Delivery.

Functional Requirement	Traced SLS Requirement	CI Test	Test Case	Test Method			
				Inspection	Analysis	Demo	Test
1.2.2.1.1.1	2.3.1.2	Thor CIT	3.1			✓	
1.2.2.1.1.2	2.3.1.2	Thor CIT	3.1			✓	
1.2.2.2.1.1	2.3.1.1	Thor CIT	3.1			✓	
1.2.2.3.1.1	2.3.2.3	Thor CIT	3.7			✓	
1.2.2.3.1.2	2.3.2.3	Thor CIT	3.7			✓	
1.2.2.4.1.1	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.2	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.3	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.4	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.5	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.6	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.7	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.4.1.8	2.2.10.2.2	Thor CIT	3.2			✓	
1.2.2.5.1.1	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.2	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.3	2.2.10.2.2	Thor CIT	3.3			✓	

Functional Requirement	Traced SLS Requirement	CI Test	Test Case	Test Method			
				Inspection	Analysis	Demo	Test
1.2.2.5.1.4	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.5	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.6	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.7	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.8	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.5.1.9	2.2.10.2.2	Thor CIT	3.3			✓	
1.2.2.6.1.1	2.4.7.6	Thor CIT	3.6			✓	
1.2.2.6.1.2	2.4.7.6	Thor CIT	3.7			✓	
1.2.2.6.1.3	2.4.7.6	Thor CIT	3.6			✓	
1.2.2.7.1.1	2.4.7.6	Thor CIT	3.4			✓	
1.2.2.7.1.2	2.4.7.6	Thor CIT	3.4			✓	
1.2.2.7.1.3	2.4.7.6	Thor CIT	3.4			✓	
1.2.2.7.1.4	2.4.7.6	Thor CIT	3.8			✓	
1.2.2.8.1.1	2.4.7.6	Thor CIT	3.2			✓	
1.2.2.9.1.1	2.4.7.6	Thor CIT	3.4			✓	
1.2.2.9.1.2	2.4.7.6	Thor CIT	3.4			✓	
1.2.2.10.1.1	2.4.7.6	Thor CIT	3.5			✓	
1.2.2.10.1.2	2.4.7.6	Thor CIT	3.5			✓	
1.2.3.11.1.1	2.4.7.6	Thor CIT	3.2			✓	

Inspection - Visually inspect the item being tested. Examples include code inspections, checking vendor documentation (manuals or Certificates of Compliance) for assertion that products (hardware or software) adhere to required standards

Analysis - Record measurements of the item under test and verify compliance by formal evaluation of those measurements. Examples include statistical analysis of network performance based on simulated data flow (data throughput vs. network load factor), evaluating system reliability based on analysis of problem reports.

Demonstration - Showing that a given function happens as expected, generally using an ops scenario.

Test -

Verifying the results of a function or process rather than the function/process itself. Examples include measuring the voltage coming out of a power distribution unit, showing that a software calculation gives the correct answer.

APPENDIX C RESOURCE REQUIREMENTS

This appendix is not required

APPENDIX D STANDARD TEST OPERATING PROCEDURES

This Appendix is not required.